

INTERPRETING DATA FROM SOLUBILITY CURVES

DIRECTIONS: Use the solid solubility curve given to you to solve the following problems.

To start, use your ion sheet to write formulas for the following compounds.

Potassium Nitrate _____

Sodium Chloride _____

Potassium Chloride _____

_____ 1) What is the solubility of potassium nitrate in 100 grams of water at 90°C?

_____ 2) What is the solubility of potassium chloride in 100 grams of water at 50°C?

_____ 3) What is the solubility of sodium chloride in 100 grams of water at 90°C?

_____ 4) What is the minimum temperature needed to dissolve 180 grams of potassium nitrate in 100 grams of water

_____ 5) At what temperature do potassium chloride and potassium nitrate have the same solubility?

_____ 6) If 110 grams of potassium chloride are mixed with 100 grams of water at 20 °C, how much will *not* dissolve?

_____ 7) If 250 grams of potassium nitrate are mixed with 100 grams of water at 80 °C, how much will *not* dissolve?

_____ 8) If 15 grams of potassium chloride are added to 100 grams of water at 30 °C, how much more must be added to make a saturated solution?

_____ 9) If 170 grams of potassium nitrate are added to 100 grams of water at 80 °C, how much more must be added to saturate the solution?

_____ 10) If 100 grams of water at 90 °C are saturated with potassium nitrate. If this solution is cooled to 30°C, how much of the solid will precipitate (change from the dissolved state to the solid state)?

_____ 11) How much potassium nitrate will dissolve in *50 grams of water* at 95 °C?

_____ 12) How much potassium chloride will dissolve in *25 grams of water* at 80 °C?

Molarity Worksheet AΣ

Calculate the molarities of the following solutions:

- 1) 2.3 moles of NaCl in 0.45 liters of solution.
- 2) 1.2 moles of CaCO_3 in 1.22 liters of solution.
- 3) 120 grams of $\text{Mg}(\text{NO}_3)_2$ in 240 mL of solution.
- 4) 98 grams of NaOH in 2.2 liters of solution.
- 5) 23 grams of NH_3 in 750 mL of solution.

How many grams of each solute do you need to make the following aqueous solutions?

- 6) 2.0 L of 6.0 M HCl
- 7) 1.5 L of 2.0 M NaOH
- 8) 0.75 L of 0.25 M Na_2SO_4
- 9) 450 mL of 0.12 M NaCl

MOLARITY (M)

Name _____

$$\text{Molarity} = \frac{\text{moles of solute}}{\text{liter of solution}}$$

Solve the problems below.

1. What is the molarity of a solution in which 58 g of NaCl are dissolved in 1.0 L of solution?

2. What is the molarity of a solution in which 10.0 g of AgNO_3 is dissolved in 500. mL of solution?

3. How many grams of KNO_3 should be used to prepare 2.00 L of a 0.500 M solution?

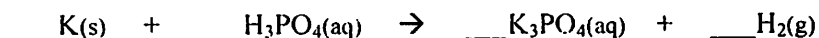
4. To what volume should 5.0 g of KCl be diluted in order to prepare a 0.25 M solution?

5. How many grams of $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ are needed to prepare 100. mL of a 0.10 M solution?

AE Solution Stoichiometry

In the space below copy the entire Stoichiometry Flow Chart from your notes to use as a reference as you do the problems on this worksheet.

Use the following reaction to answer the questions below.

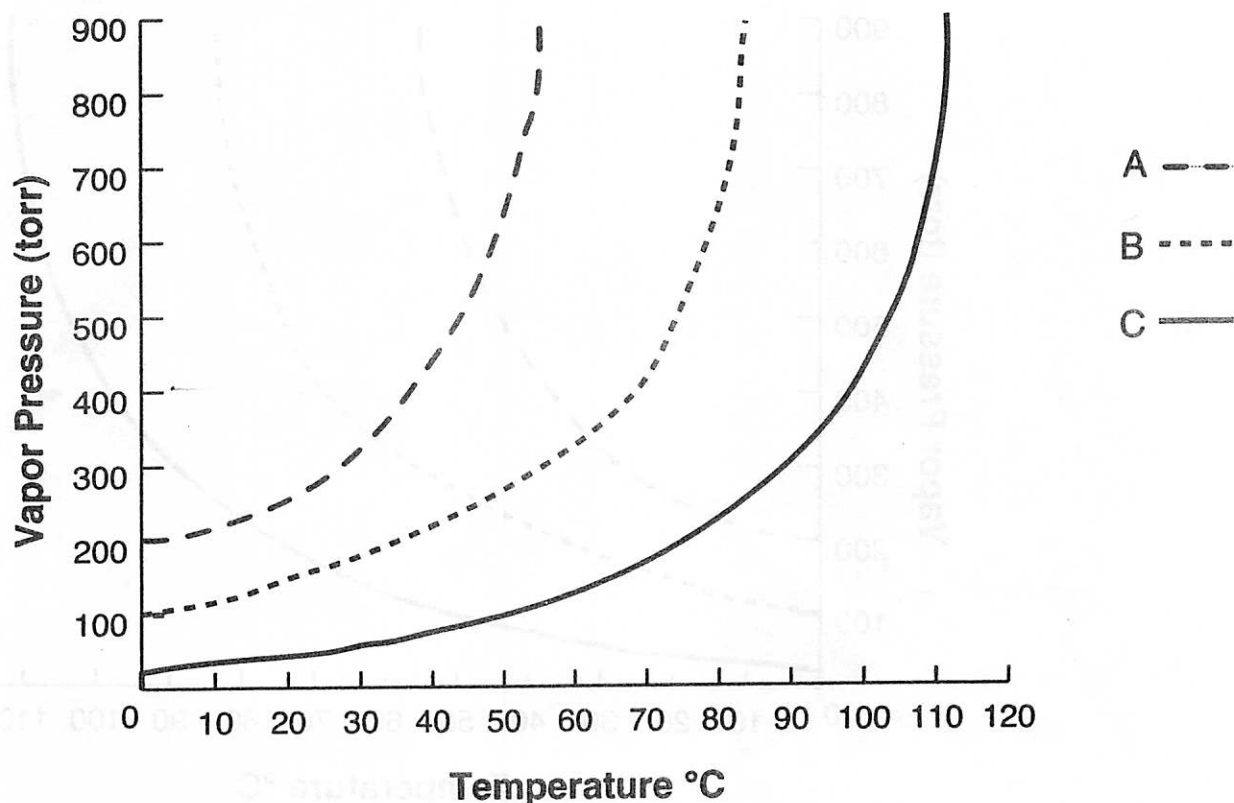


1. When 13.0 g of K react, what concentration of K_3PO_4 will result if the final solution volume is 2.0 L?
2. If 0.300 L of 2.0 M H_3PO_4 are used, what volume of **hydrogen gas** will be produce at STP?
3. If 300 mL of 0.25 M K_3PO_4 are produced, what mass of K was used?
4. When 44.8 L of hydrogen gas were produced, what was the initial concentration of H_3PO_4 used? Assume the volume of solution was 1.5 L.

VAPOR PRESSURE AND BOILING

Name _____

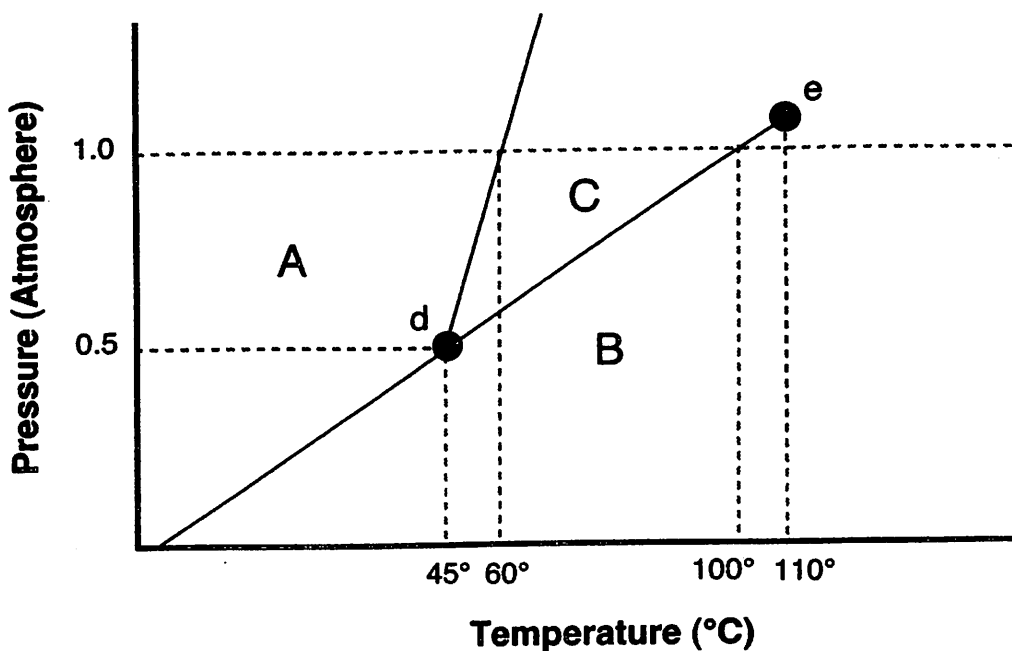
A liquid will boil when its vapor pressure equals atmospheric pressure. Answer the questions following the graph.



1. At what temperature would Liquid A boil at an atmospheric pressure of 400 torr? _____
2. Liquid B? _____
3. Liquid C? _____
4. How low must the atmospheric pressure be for Liquid A to boil at 35° C? _____
5. Liquid B? _____
6. Liquid C? _____
7. What is the normal boiling point of Liquid A? _____
8. Liquid B? _____
9. Liquid C? _____
10. Which liquid has the strongest intermolecular forces? _____

PHASE DIAGRAM

Name _____



Answer the following questions using the chart above.

1. What section represents the solid phase? _____
2. What section represents the liquid phase? _____
3. What section represents the gas phase? _____
4. What letter represents the triple point? _____
5. What letter represents the critical point? _____
6. What is this substance's normal melting point? _____
7. What is this substance's normal boiling point? _____
8. Above what temperature is it impossible to liquify this substance no matter what the pressure? _____
9. At what temperature and pressure do all three phases coexist? _____
10. Is the density of the solid greater than or less than the density of the liquid?

11. Would an increase in pressure cause this substance to freeze or melt? _____

Changes of State

Section Review 13.3

DIRECTIONS: Write on the line at the right of each statement the letter preceding the word or expression that best completes the statement.

1. When melting and freezing proceed at the same rate, the system is (a) sublimated; (b) amorphous; (c) metallic; (d) in equilibrium. _____ 1
2. Whenever a liquid changes to a vapor, it (a) absorbs heat energy from its surroundings; (b) is in equilibrium with its vapor; (c) is boiling; (d) is condensing. _____ 2
3. If the concentration of vapor above a liquid is zero, then (a) no condensation can occur; (b) the rate of evaporation is high; (c) the rate of condensation is high; (d) no further evaporation can occur. _____ 3
4. In terms of the kinetic theory, what is the effect on a liquid-vapor equilibrium system if the temperature of the liquid is raised? (a) The average kinetic energy of the molecules is decreased. (b) The rate of evaporation is decreased. (c) The concentration of vapor molecules above the liquid surface is decreased. (d) Eventually, equilibrium is reestablished but at a higher vapor pressure. _____ 4
5. Le Châtelier studied (a) dynamic equilibria; (b) static equilibria; (c) lattice structure; (d) amorphous solids. _____ 5
6. If a system at equilibrium is subjected to stress, the equilibrium will be displaced (a) in the direction of the stress; (b) and immediately return to the starting point; (c) so as to relieve the stress; (d) until the temperature is lowered. _____ 6
7. The equilibrium vapor pressure of a liquid is (a) the same for all liquids; (b) the pressure exerted by a vapor in equilibrium with its liquid at a given temperature; (c) constant for a particular liquid at all temperatures; (d) measured only at 0°C. _____ 7
8. As the temperature of a liquid increases, its equilibrium vapor pressure (a) increases; (b) decreases; (c) remains constant; (d) decreases until boiling is reached and then increases. _____ 8
9. A volatile liquid is one which (a) has strong attractive forces between particles; (b) evaporates readily; (c) has an odor; (d) is ionic. _____ 9
10. Glycerol boils at a slightly higher temperature than does water. This indicates that glycerol's attractive forces are (a) nonexistent; (b) weaker than water; (c) the same as those of water; (d) stronger than water. _____ 10
11. A phase diagram indicates the conditions under which (a) the various states of a substance exist; (b) amorphous solids become crystalline; (c) Le Châtelier's principle no longer applies; (d) all vapors become flammable. _____ 11
12. The triple point of a substance represents the only conditions at which (a) a solid vaporizes; (b) states of a substance coexist at equilibrium; (c) a substance melts, freezes and boils; (d) equal amounts of solid, liquid, and gas occur. _____ 12

DIRECTIONS: Write on the line at the right of each statement the word or expression that best completes the meaning when substituted for the corresponding number.

13. During the process of (13), a substance changes from a solid to a vapor without passing through the liquid phase. _____ 13
14. During boiling, the temperature of a liquid (14). _____ 14
15. The conditions that are graphed in a phase diagram are (15) versus pressure. _____ 15

Concentrations of Solutions

Section Review 14.3

DIRECTIONS: Write on the line at the right of each statement the letter preceding the word or expression that best completes the statement.

1. Which of the following is expressed in terms of solution volume? (a) molality (b) molarity (c) percent concentration by mass (d) all of the above _____ 1
2. The symbol m stands for (a) volume; (b) molality; (c) percent concentration by mass; (d) molarity. _____ 2
3. Which concentration expression is common for solutions used for practical purposes in the home, in industry, and in medicine? (a) percent concentration by mass (b) molarity (c) molality (d) all of the above are used equally _____ 3
4. Which concentration expression is most often used in chemistry? (a) percent concentration by mass (b) molarity (c) molality (d) all of the above are used equally _____ 4
5. A solution that contains a low concentration of solute must be (a) unsaturated and dilute; (b) saturated and dilute; (c) dilute, but may be saturated or unsaturated; (d) saturated, but may be dilute or concentrated. _____ 5

DIRECTIONS: Write the answer to questions 6–12 on the line to the right, and show your work in the space provided.

6. What is the molarity of a solution that contains 125 g NaCl in 4.00 L solution? _____ 6
7. What is the molality of a solution that contains 31.0 g HCl in 500 g water? _____ 7
8. What is the percent concentration by mass of a solution that contains 4.2 g NaNO_3 in 60.0 g water? _____ 8
9. How many moles of HCl are present in 0.70 L of a 0.33 M solution of HCl? _____ 9
10. What mass of NaCl is contained in a water solution that has a concentration of 2.48 m and that contains 806 g water? _____ 10
11. What is the molarity of a solution that contains 0.202 mol KCl in 7.98-L solution? _____ 11
12. What is the molality of a solution that contains 5.10 mol KNO_3 in 4.47 kg water? _____ 12

DIRECTIONS: In the parentheses at the right of each expression in the first column, write the letter of the expression in the second column that is most closely related.

- | | | |
|------------------------------------------------------------|-----|----------------------------------|
| 13. $\frac{\text{mol solute}}{\text{L solution}}$ | () | a. density |
| 14. $\frac{\text{mol solute}}{\text{kg solvent}}$ | () | b. percent concentration by mass |
| 15. $\frac{\text{g solute}}{\text{g solution}} \times 100$ | () | c. molarity |
| | | d. volume |
| | | e. molality |

Colligative Properties of Solutions

Section Review 14.4

DIRECTIONS: Write on the line at the right of each statement the letter preceding the word or expression that best completes the statement.

1. How does the temperature range over which a solution remains liquid compare to the range over which the corresponding pure solvent remains liquid? (a) the solution's range is narrower (b) the solution's range is wider (c) the two ranges are equal (d) any of the above may be true, depending on the solvent _____ 1
2. Antifreezes (a) lower both vapor pressure and freezing point; (b) lower neither vapor pressure nor freezing point; (c) lower vapor pressure but not freezing point; (d) lower freezing point but not vapor pressure. _____ 2
3. Assume that equal masses of two nonvolatile solutes of different molar masses are dissolved in two identical water samples. How do the freezing-point depressions of the two resulting solutions compare? (a) the depression for the higher-molar-mass solute will be less (b) the depression for the higher-molar-mass solute will be greater (c) the two depressions will be equal (d) any of the above might be the case, depending on the particular solute _____ 3
4. Solute molar mass can be determined by boiling-point-elevation studies, assuming that the pure solute (a) is an electrolyte; (b) is volatile; (c) is nonvolatile; (d) is liquid at the boiling temperature of water. _____ 4

DIRECTIONS: Write the answer to questions 5–11 on the line to the right, and show your work in the space provided.

5. What is the freezing point of a solution that contains 2.00 mol solute per kilogram water? _____ 5
6. What is the molality of a water solution that freezes at -0.633°C ? _____ 6
7. What is the boiling-point elevation of a solution that contains 4.15 mol solute per kilogram water? _____ 7
8. What is the freezing point of a solution that contains 1.99 g of a molecular solute of molar mass 58.5 g/mol in 58.0 g water? _____ 8
9. What is the molar mass of a molecular solute, if dissolving 100. g of the solute in 1000 g water produces a solution that freezes at -2.12°C ? _____ 9
10. What is the molar mass of a nonelectrolyte solute, if dissolving 0.876 g of the solute in 15.0 g water produces a solution that freezes at -1.47°C ? _____ 10
11. How many grams of a solute that has a molar mass of 164 g/mol must be added to 1.330 kg water to produce a solution that freezes at -4.13°C ? _____ 11

DIRECTIONS: Complete the following statements, forming accurate sentences.

12. In calculations involving colligative properties, concentrations are expressed in terms of _____ 12
13. The units of m are _____ 13
14. The symbol for freezing point depression is _____ 14
15. The ability of a substance to affect colligative properties depends upon its _____ 15